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IS 14221 (1995): Automotive vehicles - Retroreflective sheets and tapes [TED 11: Automotive Electrical Equipment]

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Indian Standard

AUTOMOTIVE VEHICLES — RETRO-REFLECTIVE SHEETS AND TAPES — SPECIFICATION

UDC 629.113.018.38

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

April 1995

Price Group 3

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Automotive Basic Standards Sectional Committee had been approved by the Transport Engineering Division Council.

Retro-reflective sheets and tapes are being increasingly used as a prime safety aid for easy, smooth and safe operation of automotive vehicles on both urban roads and highways. The affixing of these tapes adds to the existing safety pre-requisites fitted on the vehicles and is intended as auxiliary safety aid for warning the unwary vehicles, pedestrians and others of a hazard and as side markers indicating the outer limits and projections in the case of heavy vehicles, etc.

In the preparation of this standard considerable assistance has been drawn from JIS Z 9117-1984 'Retro-reflective sheeting and tapes for safety', issued by the Japanese Industrial Standards Committee (JISC).

The committee responsible for preparation of this standard is given in Annex A.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

AUTOMOTIVE VEHICLES — RETRO-REFLECTIVE SHEETS AND TAPES — SPECIFICATION

1 SCOPE

This standard specifies requirements for retro-reflective sheets and tapes for use in vehicles, road signs and other road accessories, lower parts of poles, railroad crossing barriers and the like for ensuring safety and smooth flow of traffic.

2 REFERENCES

The following Indian Standards are necessary adjuncts to this standard:

IS No.	*Title*
2500 (Part 1) : 1992	Sampling inspection procedures: Part 1 Attribute sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection (*second revision*)
3105 : 1980	General requirements for automobile lighting and signalling devices (*first revision*)

3 TERMINOLOGY

For the purpose of this standard the following definitions shall apply.

3.1 Road Signs

Signs specified in the ordinance concerning road contours, dividing lines and road markings such as crossing, speed breakers.

3.2 Road Accessories

Various installations ancillary to road regulations, such as guard rails, culverts, etc.

3.3 Retro-reflection

The phenomenon in which light is reflected to the illuminating direction of the light.

3.4 Illumination Axis

The axis connecting the projector and the centre of the test piece surface.

3.5 Observation Axis

The axis connecting the receptor and the centre of the test-piece surface.

3.6 Observation Angle

The angle included between the illumination axis and observation axis.

3.7 Entry Angle

The angle included between the illumination angle and the normal line to the test piece surface at its centre.

3.8 Retro-reflection Coefficient (R_c)

The quotient obtained by dividing the luminous intensity (I) of the light reflected by the retro-reflective surface in the direction of the observation angle by the product of the illuminance (E_s) received by the retro-reflective surface placed perpendicular to the direction of the incident light and the area (A) of the retro-reflective surface (*see* Fig. 1):

$$R_c = \frac{I}{E_s . A}$$

The retro-reflection coefficient is expressed in cd/lux/m^2.

4 GRADES AND TYPES

4.1 Retro-reflective sheets shall be classified into two grades according to the reflection performance and into two types according to the kind of adhesives used, as shown in Table 1.

4.2 Grade 1 sheets shall be used in outdoor environments exposed to sunlight throughout the year and Grade 2 sheets shall be used in environments in which the frequency of the exposure to direct sunlight and wind or rain is low.

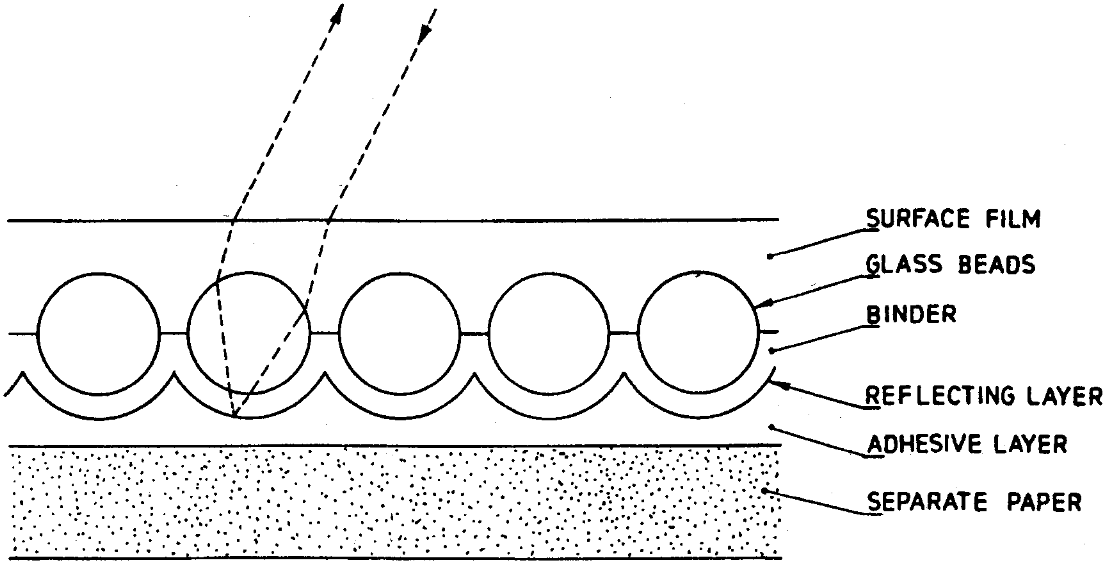

FIG. 1 CONSTRUCTION (EXAMPLE)

Table 1 Grades and Types
(*Clause* 4.1)

Types Grade	Pressure Bonding Type	Hot Pressure Bonding Type
Grade 1	R 1 - P	R 1 - H
Grade 2	R 2 - P	R 2 - H

5 CONSTRUCTION

Retro-reflective sheets shall have a construction in which, as shown in Fig. 1, the illuminant light is transmitted through the surface film, glass beads and binder layer to the reflecting layer, during the process it is coloured by the pigment intermixed in the surface film or binder, and the coloured light is retro-reflected in the illuminating direction. In addition, the back surface of the retro-reflecting sheet shall be applied with an adhesive for sticking on to other objects, and this adhesive layer shall be protected with separate paper.

6 PERFORMANCE REQUIREMENTS

Retro-reflecting sheets shall be checked with respect to the performance, construction and material and shall comply with the requirements specified below.

6.1 Colour

The colour of retro-reflective sheets shall be as specified in **4.2** of IS 3105 : 1980.

6.2 Reflection Performance

The reflection performance values of retro-reflective sheets shall not be less than the values shown in Table 2 for Grade 1 and not less than the values shown in Table 3 for Grade 2 when measured by the method specified in **8.3**.

Table 2 Reflection Performance of Grade 1 Sheets

Observation Angle	Entrance Angle (y)	White (W)	Yellow (Y)	Red (R)	Yellowish RED (YR)	Green (G)	Blue (B)
20′	5°	50.0	35.0	10.0	20.0	7.0	2.0
	30°	24.0	16.0	4.0	4.5	3.0	1.0
	40°	9.0	6.0	1.8	2.0	1.2	0.4
1°30′	5°	5.0	3.0	0.8	1.2	0.6	0.2
	30°	2.5	1.5	0.4	0.6	0.3	0.1
	40°	1.5	1.0	0.3	0.4	0.2	0.06

Table 3 Reflection Performance of Grade 2 Sheets
(*Clause* 6.2)

Observa-Tion Angle	Entrance Angle (y)	White (W)	Yellow (Y)	Red (R)	Yellowish RED (YR)	Green (G)	Blue (B)
20′	5°	25.0	15.0	5.0	9.0	3.5	2.0
	30°	12.0	10.0	3.0	3.5	2.0	1.0
	40°	6.0	4.0	1.0	1.5	0.8	0.4
1° 30′	5°	4.0	2.2	0.6	1.0	0.4	0.2
	30	1.8	1.0	0.3	0.5	0.2	0.09
	40°	1.0	0.8	0.1	0.3	0.1	0.06

6.3 Glossiness

The values of glossiness of retro-reflective sheets shall not be less than 40 when measured by the method specified in **8.4**.

7 SAMPLING

Unless otherwise agreed to between the purchaser and the supplier, retro-reflective sheets and tapes shall be selected at random from the lot offered for acceptance as per IS 2500 (Part 1) : 1992.

8 TESTS

8.1 Test Conditions

The test conditions for retro-reflective sheets shall be as follows.

8.1.1 *Atmospheric Condtions for Testing*

Unless otherwise specified, the atmospheric conditions shall be a temperature of 20 to 35 °C and a relative humidity of 65 ± 5 percent.

8.1.2 *Test Specimen*

The pieces used shall be cut out from the original sheet, hereinafter referred to as the pieces 'A', and test pieces prepared by sticking the original sheet on to aluminium plates, hereafter referred to as pieces 'B'.

8.1.3 *Preparation of Test Specimen 'B'*

The pieces 'B' shall be prepared by carefully grinding the surface of an aluminium plate in the longitudinal direction with No. 100 emery paper, washing it with a suitable solvent such as benzene, drying it well and wiping it with a well-dried clean cloth, and then sticking the adhesive surface of the retro-reflective sheet on the surface of the thus pre-treated aluminium plate. The thickness of the aluminium plate shall not be less than 0.5 mm.

8.1.4 *Pre-treatment of Test Specimen*

Both pieces 'A' and 'B' shall be left standing before testing for 24 h under the temperature and humidity conditions specified in **8.1.1**.

8.2 Measurement of Colour

8.2.1 The measurement of colour of retro-reflecting sheets shall be performed under the geometric conditions of illumination and reception by illuminating the samples from the direction of 45° and receiving the reflected light of the pieces of retro-reflecting sheets.

8.3 Measurement of Retro-reflection Performance

8.3.1 The retro-reflection performance of retro-reflective sheets shall be measured as follows.

8.3.2 *Test Pieces*

Three pieces 'B' each 70 mm in width and 150 mm in length shall be arranged to form a rectangle of 210 mm × 150 mm and subjected to the retro-reflection performance test.

8.3.3 *Test Apparatus*

The test apparatus shall consist of a projector having an emitting opening of 50 mm or smaller in diameter and a photoelectric receptor having an effective diameter of 26 mm or smaller, and as shown in Fig. 2, the distance '*d*' between the test piece surface and the receptor surface shall be adjusted to 15.0 m or longer. In this case, the light source used shall be the standard source A, and the spectral sensitivity of the receptor used shall agree with the relative luminous efficiency of the standard observer. In addition, the illuminance of the incident light on the test piece surface shall be as uniform as possible.

8.3.4 *Observation Angle and Entry Angle*

The observation angle values used shall be 20′ and 1° 30′, and the entrance angle values used shall be 5°, 30° and 40°. In this case, the directions of observation angle and entrance angle shall be taken as positive in the anti-clockwise direction.

8.3.5 *Measurements*

Illuminance E_s, shall be measured with the receptor placed at the position of the test piece and right opposite the projector. Then returning the arrangement to that shown in Fig. 2, the values of illuminance E_r on the receptor produced by the reflection from the test piece shall be measured with respect to three entry angles respectively at

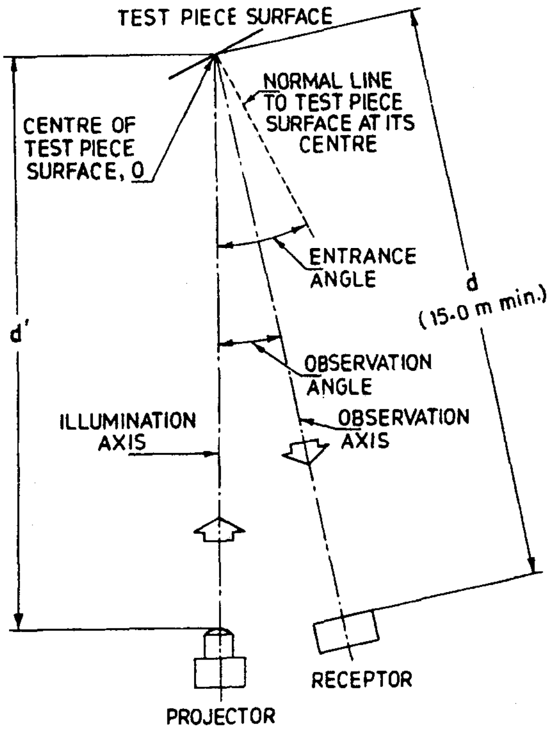

FIG. 2 RETRO-REFLECTION PERFORMANCE TESTING APPARATUS

three observation angles, and the retro-reflection coefficient R_c shall be calculated from the following formula:

$$R_c = \frac{I}{E_s \cdot A}$$

where

R_c = retro-reflection coefficient,

E_s = illuminance on the plane normal to incident light at centre of test piece (lx), and

A = surface area of test piece (m^2),

I = luminous intensity (cd) in the direction of observation axis produced by test piece, to be calculated from the following formula :

$$I = E_r \cdot d^2$$

where

E_r = illuminance on receptor in the arrangement of Fig. 2 in lux (lx), and

d = distance between the centre of test piece surface and the receptor in metres (m).

8.4 Measurement of Glossiness

8.4.1 The glossiness of retro-reflective sheets shall be measured by any suitable method (60° specular glossiness) two times with 3 pieces B of 70 mm in width and 150 mm in length.

8.5 Peel Test of Protective Paper

8.5.1 The peeling test for the protective sheet shall be performed by placing a weight weighing 175 g per cm^2 on a retro-reflective sheet of 50 mm in width and 150 mm in length, and after leaving it standing for 4 h in a thermostatic bath at 70 ± 2°C, withdrawing and letting it cool under the test conditions of **8.1.1**, and peeling off the separate paper by finger tips without using water or solvent. During the process of peeling the separate paper, examination shall be made for the occurrence of abnormalities such as splitting of the separate paper or transfer of the adhesives to the separate paper. The test pieces prepared shall be five pieces 'A', of which three shall be used for this test.

8.6 Elongation and Tensile Strength Test

8.6.1 A piece 'A' of 25 mm in width and 350 mm in length shall be fixed with gripping tools, leaving a length of 25 mm from each end free to make the gripping distance 300 mm, and the elongation and tensile strength shall be measured at a pulling speed of 300 mm/min the number of test piece shall be three.

After the test, the elongation shall not be less than 10 percent and tensile strength shall not be less than 22 N (2.25 kgf).

8.7 Shrinkage Test

8.7.1 After measuring accurately the dimensions of three pieces of 'A' of 225 mm × 225 mm in size, the protective paper shall be peeled off, and each piece shall be kept aside with the adhesive surface directed upward on a horizontal plane. The shrinkage value shall be measured after 10 min and 24 h, respectively. The number of test specimen shall be three.

After the test, retro-reflective sheets shall not shrink by 0.8 mm or more in 10 minutes and by 3.2 mm or more in 24 hours.

8.8 Flexibility Test

8.8.1 A piece 'B' of 70 mm in width and 280 mm in length, with its reflective surface facing upward, shall be wound around rod of 19 mm in diameter to about 180 degrees in one second, and examination shall be carried out on the existance of abnormalities on the reflective surface. The number of test specimen shall be three.

9 DESIGNATION

Retro-reflective sheets/tapes shall be designated by their grades, types, adhesive bonding, colour followed by the number of this Indian Standard.

> For example : 11 PR IS 14221 shall designate retro-reflective tape/sheet of Grade 1, Type 1, pressure bonding with red colour.

10 MARKING

10.1 Each retro-reflective sheet shall be legibly and indelibly marked with the following at a suitable location on each package:

a) Manufacturer's name or trade-mark, if any;
b) Designation; and
c) Month and year of manufacture.

10.2 BIS Certification Marking

The product may also be marked with Standard Mark.

10.2.1 The use of the Standard Mark is governed by the provisions of the Bureau of Indian Standards Act, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to the manufacturers or producers may be obtained from the Bureau of Indian Standards.

ANNEX A

(Foreword)

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